CLAIMS

1. A tire having an asymmetric tread pattern which designates directions to inner and outer sides of a vehicle when the tire is mounted on the vehicle, wherein at least two circumferential grooves extending along an equatorial plane of the tire are formed in a region of a tread surface at an axially inner side with respect to the equatorial plane in the mounting on the vehicle and at least one circumferential groove is formed in a region at an axially outer side thereof, and a circumferential groove nearest to the equatorial plane of the tire among the circumferential grooves arranged in the axially inner side region has a width wider by 20% or more than an average groove width of the tire and a circumferential groove arranged toward a side of a tread end at the axially inner side region has a width corresponding to 90-110% of the average groove width, and the circumferential groove nearest to the equatorial plane of the tire at the axially outer side region has a width narrower by 10% or more than the average groove width.

2. A tire having an asymmetric tread pattern according to claim 1, wherein one circumferential groove is arranged in the axially outer side region and the circumferential groove arranged in the axially inner side region and nearest to the equatorial plane of the tire has a width corresponding to 120-145% of the average groove width.

3. A tire having an asymmetric tread pattern according to claim 1, wherein two circumferential grooves are arranged in the axially outer side region and the circumferential groove arranged in the axially inner side region and nearest to the equatorial plane of the tire has a width corresponding to 130-160% of the average groove width.

4. A tire having an asymmetric tread pattern according to any one of claims 1 to 3, wherein a rib-like land part extending along the equatorial plane of the tire is arranged on or in the vicinity of the equator of the tire sandwiched between the circumferential grooves, and the rib-like land part has a center in the widthwise direction of the tire positioned from the equatorial plane of the tire toward a side of

elongating a circumferential length of a ground contact area of the tread when a negative camber is applied to the tire and is provided with plural fine grooves extending in a direction crossing with the equatorial plane of the tire, and the fine groove has a portion extending in a direction inclined with respect to a radial direction of the tread in the tire, and further a circumferential groove located at the side of elongating the circumferential length of the ground contact area of the tread among the two circumferential grooves sandwiching the rib-like land part has a wide-width.

5. A tire having an asymmetric tread pattern according to claim 4, wherein the fine groove has an inclination angle of 5-55° with respect to the widthwise direction of the tire.

6. A tire having an asymmetric tread pattern according to claim 4 or 5, wherein the fine groove is opened at the surface of the tread.

7. A tire having an asymmetric tread pattern according to claim 4, 5 or 6, wherein an opening width of the fine groove is not more than 2 mm.

8. A tire having an asymmetric tread pattern according to claim 4 or 5, wherein the fine groove is closed at the surface of the tread.

9. A tire having an asymmetric tread pattern according to any one of claims 1 to 3, wherein a rib-like land part extending along the equatorial plane of the tire is arranged on or in the vicinity of the equator of the tire sandwiched between the circumferential grooves, and the rib-like land part has a center in the widthwise direction of the tire positioned from the equatorial plane of the tire toward a side of elongating a circumferential length of a ground contact area of the tread when a negative camber is applied to the tire and is provided with plural ellipsoidal recessed dimples having a major axis in a direction crossing with the equatorial plane of the tire, and further a circumferential groove located at the side of elongating the circumferential length of the ground contact area of the tread among the two circumferential grooves sandwiching the rib-like land part has a wide-width.

10. A tire having an asymmetric tread pattern according to claim 9, wherein the major axis of the dimple has an inclination angle of 5-45° with respect to the widthwise direction of the tire.

11. A tire having an asymmetric tread pattern according to any one of claims 1 to 3, wherein a total volume of lateral grooves, which may be formed in a land part at the axially inner side in the mounting on the vehicle among the land parts defined between the circumferential groove and the tread end, per a unit width in the widthwise direction of the tread over a full circumference of the tread is made smaller than a similar total volume in the land part at the axially outer side in the mounting on the vehicle.

12. A tire having an asymmetric tread pattern according to claim 11, wherein plural holes separated from the circumferential groove and having a maximum depth corresponding to not less than 1/3 of a depth of the circumferential groove are formed in the land part at the axially inner side in the mounting on the vehicle, and a volume of concave portion in a zone ranging from a line passing through a center of such a land part in the widthwise direction of the tread to the side of tread end is made larger than a volume of concave portion in a zone ranging from the line passing through the center in the widthwise direction toward a side opposite to the tread end.

13. A tire having an asymmetric tread pattern according to claim 11 or 12, wherein the land part at the axially inner side in the mounting on the vehicle is divided by a fine-width circumferential groove into a widthwise outer portion and a widthwise inner portion, and a width of the widthwise outer portion is made narrower than the widthwise inner portion and is not more than 1/10 of a tread width.

14. A tire having an asymmetric tread pattern according to claim 13, wherein at least one of curvature centers of curves constituting a profile of a side face of the widthwise outer portion in the tread at a section in the widthwise direction of the tire is positioned at an outer side of the tire, and a curvature center of a curve constituting a profile of the widthwise inner portion is positioned at an inner side of the tire.

15. A tire having an asymmetric tread pattern according to any one of claims 11 to 14, wherein a width of the fine-width circumferential groove is gradually widened from a groove bottom toward a side of the surface of the tread.

16. A tire having an asymmetric tread pattern according to any one of claims 11 to 15, wherein at least a part of a zone having plural holes in the land part at the axially inner side mounted on the vehicle is contacted with ground under an action of a load corresponding to not less than 70% of a maximum load capacity of the tire.

17. A tire having an asymmetric tread pattern any one of claims 11 to 16, wherein an opening size of the hole in the land part at the axially inner side mounted on the vehicle is made large toward a direction separating away from the equatorial plane of the tire.

18. A tire having an asymmetric tread pattern according to any one of claims 11 to 17, wherein a distance among the plural holes in the land part at the axially inner side mounted on the vehicle is made smaller toward a direction separating away from the equatorial plane of the tire.

19. A tire having an asymmetric tread pattern according to any one of claims 11 to 18, wherein a depth of the hole in the land part at the axially inner side mounted on the vehicle is made deeper toward a direction separating away from the equatorial plane of the tire.

20. A tire having an asymmetric tread pattern according to any one of claims 1 to 3, wherein when the tire is mounted on a wheel in which a transmission ratio of a radial force input to one end portion of a rim in the widthwise direction toward an axle is larger than the similar transmission ratio of a force input to the other end portion of the rim in the widthwise direction, a total volume of lateral grooves, which may be formed in a land part located at a side of large transmission ratio mounted on the wheel among the land parts defined between the circumferential groove and the tread end, per unit width in the widthwise direction of the tread over a full circumference of the tread is made smaller than the similar total volume of lateral grooves

formed in the land part located at the side of the other tread end, and the land part located at a side of large transmission ratio is divided by a fine-width circumferential groove into a widthwise outer portion and a widthwise inner portion , and a plurality of holes separated from the circumferential groove and the lateral grooves are formed in the widthwise inner portion.

21. A tire having an asymmetric tread pattern according to claim 20, wherein a width of the fine-width circumferential groove is gradually widened from a groove bottom toward a side of a surface of the tread.

22. A tire having an asymmetric tread pattern according to claim 20 or 21, wherein an opening size of each of the plural holes formed in the widthwise inner portion is made larger toward a direction separating away from the equatorial plane of the tire.

23. A tire having an asymmetric tread pattern according to any one of claims 20 to 22, wherein a distance among the mutually plural holes formed in the widthwise inner portion is made smaller toward a direction separating away from the equatorial plane of the tire.

24. A tire having an asymmetric tread pattern according to any one of claims 20 to 23, wherein a depth of each of the plural holes formed in the widthwise inner portion is made deeper toward a direction separating away from the equatorial plane of the tire.

25. A tire having an asymmetric tread pattern according to any one of claims 20 to 24, wherein at least a part of a zone having plural holes in the widthwise inner portion is contacted with ground under an action of a load corresponding to not less than 70% of a maximum load capacity of the tire.

26. A tire having an asymmetric tread pattern according to any one of claims 20 to 25, wherein at least one of curvature centers of curves constituting a profile of a side face of the widthwise outer portion in the tread at a section in the widthwise direction of the tire is positioned at an outer side of the tire, and a curvature center of a curve constituting a profile of the widthwise inner portion is

positioned at an inner side of the tire.

27. A tire having an asymmetric tread pattern according to any one of claims 1 to 3, wherein an effective ground contact area of either axially inner side or axially outer side at a state that the tire is assembled on an approved rim and filled with a normal air pressure and loaded under a mass corresponding to a maximum load capacity is made larger than that of the other side, and a radial distance from a tangential line on an outer surface of the tread perpendicular to the equatorial plane of the tire to each of tread ground contact edges at a posture of filling the normal air pressure is made larger in the side having a small effective ground contact area than in the other side.

28. A tire having an asymmetric tread pattern according to claim 27, wherein a relation between a ratio of large and small of the effective ground contact area (S-large/S-small) and a ratio of large and small of the radial distance (H-large/H-small) is (S-large/S-small) = A x (H-large/H-small) in which A is 1.0-1.4.

29. A method of mounting a tire having an asymmetric tread pattern on a vehicles through a suspension giving a negative camber at full time or as needed, which comprises taking a tire as claimed in any one of claims 1 to 28 in a use form that a circumferential groove formed in an axially inner side region with respect to an equatorial plane of the tire in the mounting on a vehicle and nearest to the equatorial plane overlaps with such a position that a circumferential length of a tread ground contact region when a negative camber is applied to the tire.

30. A method of measuring vibration transmission characteristic of a wheel, which comprises mounting a wheel assembled with a tire having a sectional shape in a widthwise direction symmetric with respect to an equatorial plane onto an axle member, applying vibrations having different frequencies to each shoulder portion of a tread of the tire in a radial direction to measure a transmission ratio represented as a ratio of an axle input produced in the axle member based on the vibration applied force to the vibration applied force, and

determining an average value of the transmission ratio at each frequency every the shoulder portion to judge what average value of the transmission ratio among the determined average values is large.

31. A method of measuring vibration transmission characteristic of a wheel according to claim 30, wherein a zone of the vibration frequency applied is 300-1000 Hz.